CONFIDENTIAL


**UNIVERSITI TEKNOLOGI MALAYSIA**

# FINAL EXAMINATION

**SEMESTER I 2017/2018**

| | |
|---|---|
| **SUBJECT CODE** | **: SCSI1013** |
| **SUBJECT NAME** | **: DISCRETE STRUCTURE** |
| **YEAR/COURSE** | **:** |
| **TIME** | **:** |
| **DATE** | **:** |
| **VENUE** | **:** |

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**INSTRUCTIONS TO THE STUDENTS:**

Answer all questions in the answer booklet.

| | |
|---|---|
| **NAME** | |
| **MATRIC NO.** | |
| **SECTION** | |
| **LECTURER** | |

(This question paper consist of 9 pages including this pages)

**QUESTION 1** **[15 MARKS]**

(a) A student taking a 10-question, true/false diagnostic test knows none of the answers and must guess at each one.

(i) Compute the probability that the student gets a score of 80 or higher. (3 marks)

(ii) What is the probability that the student gets a score of 70 or lower. (2 marks)

b) Bowl A contains 2 red chips; bowl B contains two white chips and bowl C contains 1 red chip and 1 white chip. A bowl is selected at random, and one chip is taken at random from that bowl.

(i) What is the probability of selecting a white chip? (6 marks)

(ii) If the selected chip is white, what is the probability that the other chip in the bowl is red? (4 marks)

**QUESTION 2** **[15 MARKS]**

a) A graph *Z*, is shown in Figure 1 ( 5 marks)

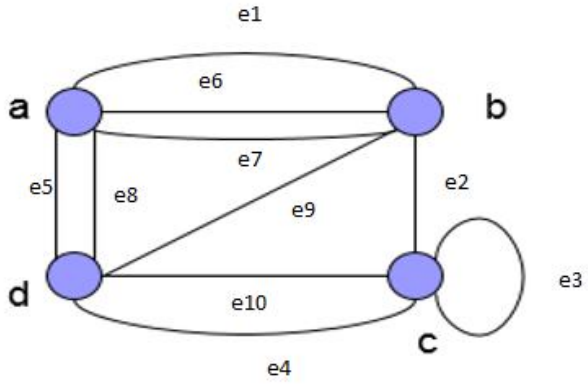


**Figure 1 : Graph *Z***

i) Determine the adjacency matrix for graph *Z*

ii) Determine the incidence Matrix for graph Z

b) Demonstrate a Hamiltonian circuit in graph *G* in Figure 2 below that begin and end at vertex, **a.** ( 2 marks)

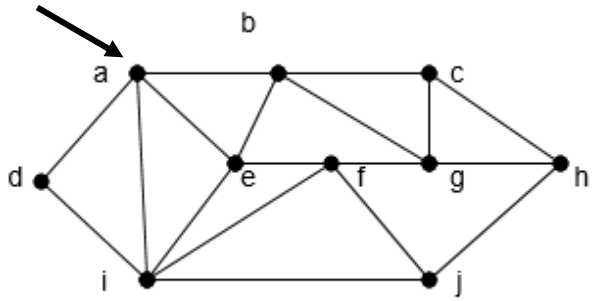


**Figure 2: Graph G**

c) Determine whether graph *Y* in Figure 3 has an Euler circuit. If exist, exhibit one (start at vertex A), otherwise, give your justification. (3 marks)

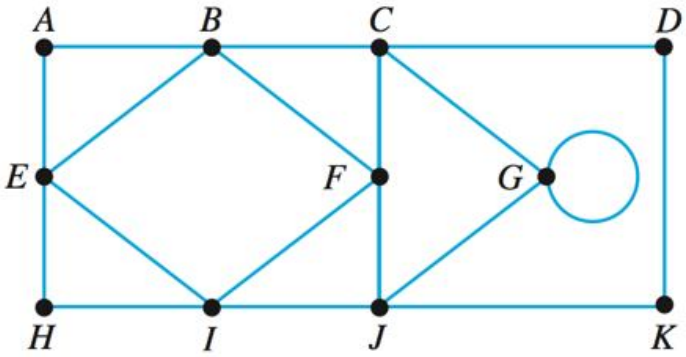


**Figure 3: Graph *Y***

d) Determine whether graph ***R*** in Figure 4 is isomorphic to graph ***S.*** ( 5 marks)

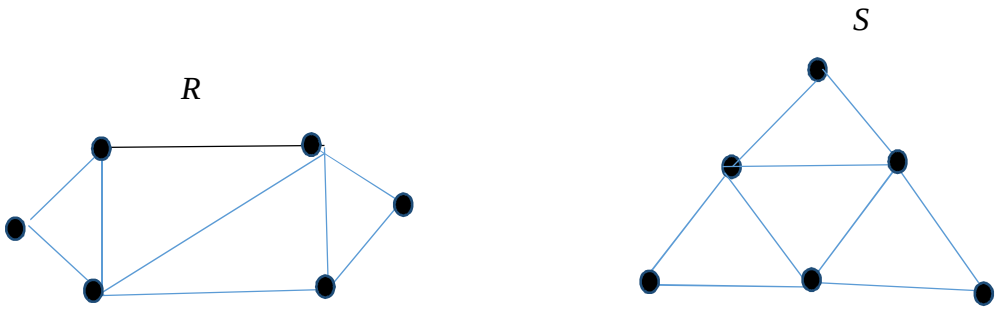


**Figure 4**

**QUESTION 3** **[10 MARKS]**

Based the graph in Figure 5, complete the Table 1 by tracing the djikstra algorithm to obtain the shortest path between the adjacent nodes.

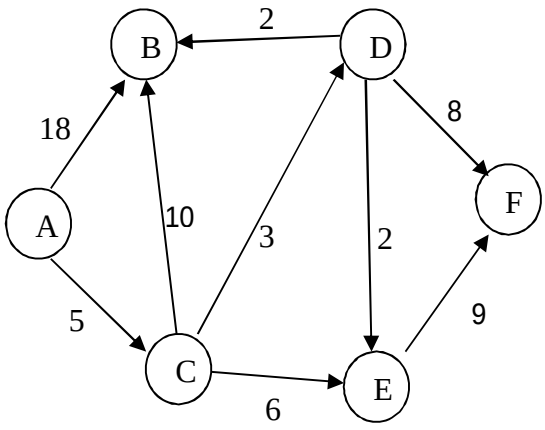


**Figure 5**

**Table 1**

| **Iteration** | *L*(A) | *L(*B) | *L*(C) | *L*(D) | *L*(E) | *L*(F) |
|---|---|---|---|---|---|---|
| **0** | 0 | ∞ | ∞ | ∞ | ∞ | ∞ |
| **1** | | | | | | |
| **2** | | | | | | |
| **3** | | | | | | |
| **4** | | | | | | |
| **5** | | | | | | |

(8 marks)

a) What is the shortest path from node *A* to node *F*. (1 mark)

b) State the path that contributes to the minimum distance. (1 mark)

**QUESTION 4** **[20 MARKS]**

a) A rooted tree, *T,* is shown in Figure 6 below,

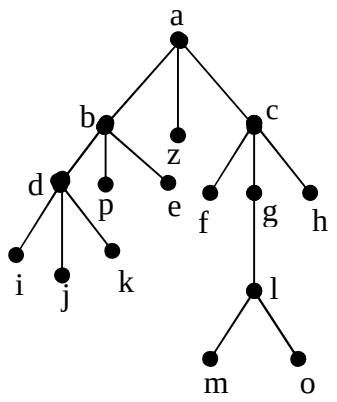


**Figure 6: Rooted tree *T***

i) Which vertex are leaves? (1 mark)

ii) List all the level-1 vertices of the tree, *T* (1 mark)

iii) List all the internal vertices of the tree, *T* (1 mark)

iv) Which vertices are decendent of vertex *g* (1 mark)

v) Is rooted tree *T*, a *m*-ary tree for some positive *m*? , Justify (2 marks)

b) Construct an ordered rooted tree that have leaves with the following universal address and determine the height of this tree,

1.1, 1.2.1, 1.2.2, 1.2.3, 2.1, 2.2.1, 2.3.1, 2.3.2, 2.4.1.1, 3.1, 3.2.1

(4 marks)

c) A chain letter starts when a person send a letter to five others. Each person who receives the letter either send it to four other people who have never received it or does not sent it anymore. Suppose 8,000 people send it out the letter before the chain end and that no one received more than one letter how many people received letter including the first person, and how many do not send it out.

(5 marks)

d) Show the results of a In-order search for the following labelled positional binary tree.
(5 marks)

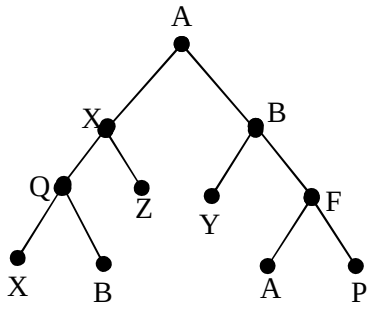


**Figure 7**

**QUESTION 5** **[20 MARKS]**

a) Let M={S, I, $q_0$, $f_s$, F) be the DFA such that S={$q_0$, $q_1$, $q_2$, $q_3$}, I={a,b}, F={$q_1$}, $q_0$=initial state and $f_s$ is given by:

$f_s(q_0, a) = q_1$, $fs(q_0, b) = q_2$

$fs(q_1, a) = q_3$, $fs(q_1, b) = q_2$

$fs(q_2, a) = q_1$, $fs(q_2, b) = q_2$

$fs(q_3, a) = q_3$, $fs(q_3, b) = q_2$

i. Construct a state transition diagram of the DFA given the state transition function, $f_s$.
(4 marks)

ii. DFA can be applied for verification of email password. Justify why DFA is suitable for verification? (1 mark)

b) Given a deterministic finite automaton (DFA) as in Figure 8.

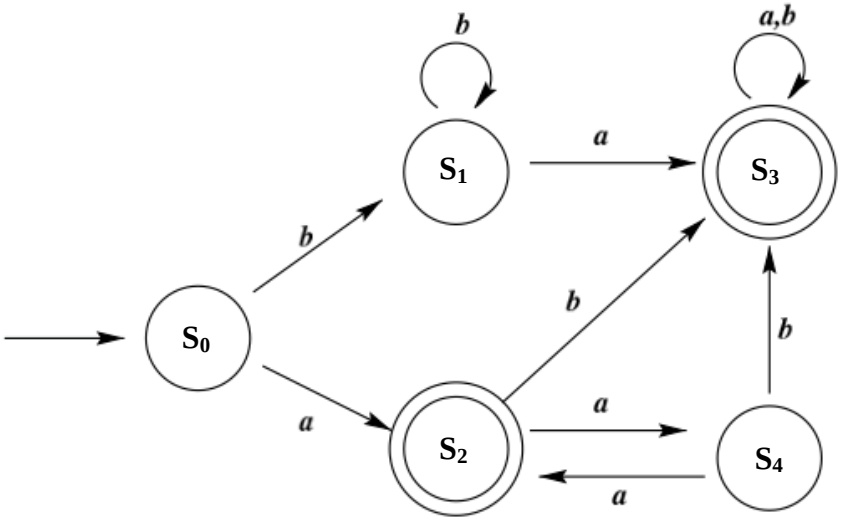


**Figure 8**

i. Construct a state transition table for state transition diagram. (5 marks)

ii. Identify whether the following input can be accepted by the DFA. Show the transition of each state for the input given. (6 marks)

a. a a a a a a

b. a b a b a b

c) Draw a transition diagram that can accept input that contains 101. (4 marks)

**QUESTION 6** **[20 MARKS]**

a) You are going to develop a simple shooting game. There is one hero in a battle field with few enemies and other characters. There are three states in the game which are *WANDER*, *EVADE* and *ATTACK*.

When the hero is wandering the field and suddenly encounters enemies while he is not in vulnerable situation, he will goes into *ATTACK* stage by shooting the enemies. However, if while wandering the field and the hero suddenly encounters enemies and he is in vulnerable situation, he will shoots the enemies and goes into *EVADE* stage.

While in *ATTACK* stage, if the hero encounters enemies and he is not vulnerable, he will remains in that stage and continues shooting. But if he encounters enemies and he is vulnerable, he will shoots and goes into *EVADE* stage. While in *EVADE* stage, if the hero encounters enemies and he is not vulnerable, he will goes into *ATTACK* stage and shoots. But if he encounters enemies and he is vulnerable, he will remains in that stage and continues shooting.

When the hero encounters characters that are not his enemies, he will not shoot. If he is in the *WANDER* stage at that time, he will continue wandering the field. If he is in *ATTACK* or *EVADE* stages, he will switch into *WANDER* stage.

The inputs and outputs are given in the Table 2 below. Construct a finite state diagram to model the game. (10 marks)

**Table 2**

| Input | Output |
|---|---|
| not enemies | shoot |
| enemies & not vulnerable | not shoot |
| enemies & vulnerable | |

b) Most modern graphical applications can temporarily display small text boxes containing helpful definitions, instructions, or suggestions when the cursor pauses over some visual

control, such as a button, a selector, or an input field. These helpful text boxes were called "balloon help" in early Apple systems. They're called infopops in some IBM products, and ScreenTips in some Microsoft products. Another generic term used is *tooltip*. Figure 9 shows an example of tooltip. Based on Figure 10 which shows the finite state transition diagram of tooltip development, construct a state transition table to represent the FSM. (10 marks)

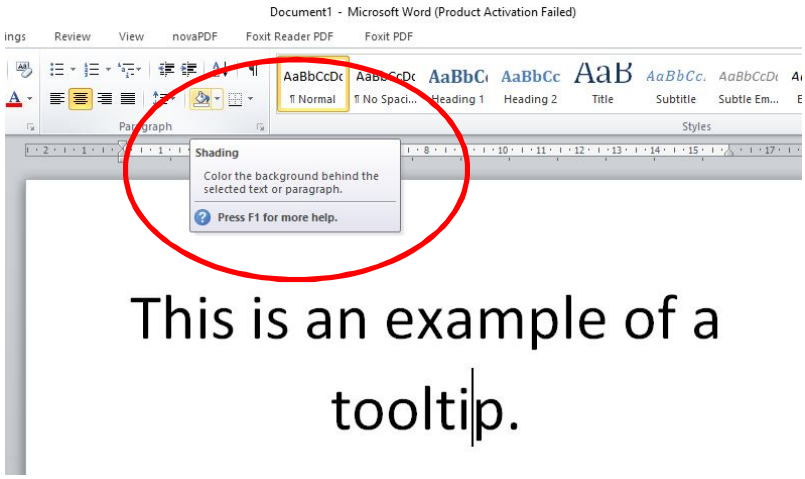


**Figure 9: A tooltip showing description of *shading* icon.**

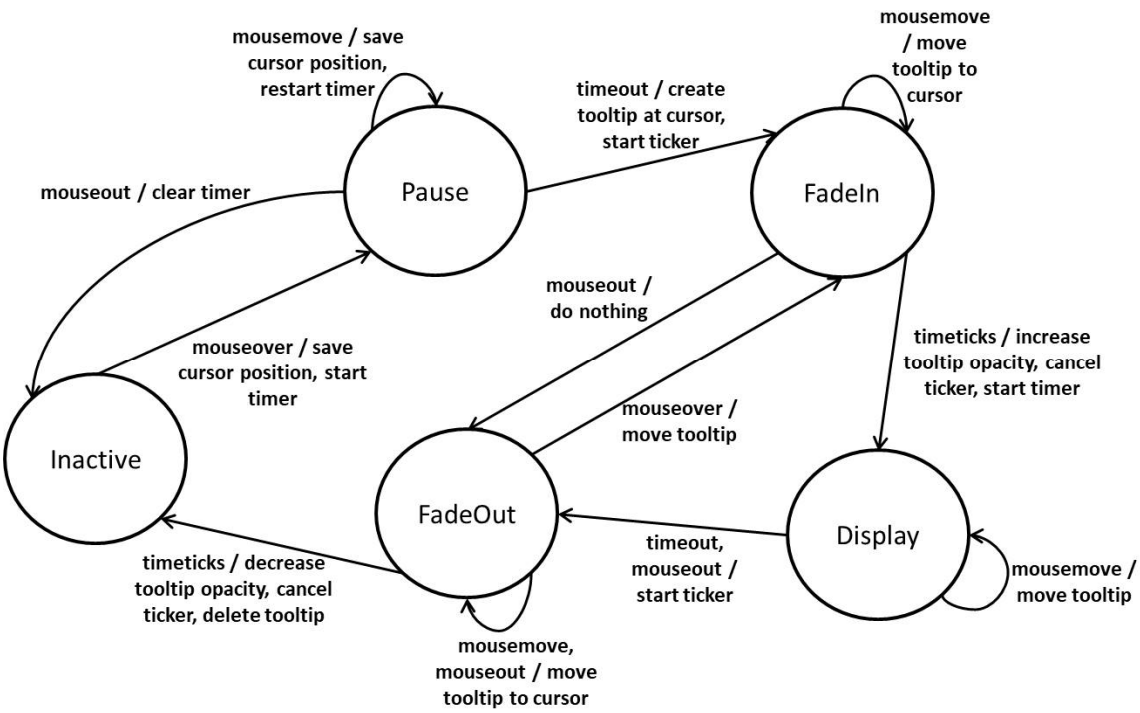


**Figure 10: Finite transition diagram of a *tooltip* FS**

**Formulas**

i) $n$ vertices has $i = (n-1)/m$ internal vertices and $l = [(m-1)n+1]/m$ leaves
ii) $i$ internal vertices has $n = mi+1$ vertices and $l = (m-1)i + 1$ leaves
iii) $l$ leaves has $n = (ml-1)/(m-1)$ vertices and $i = (l-1)/(m-1)$ internal vertices